

AMENDMENTS TO THE CLAIMS

Claims 1-14 (Canceled)

15. (Currently Amended) A method of forming a desired pattern in a surface of a substrate for a hard disk recording medium, comprising the steps of:

(a) providing a substrate in the form of a flat disk having first, upper and second, lower surfaces, said first, upper surface being coated with a layer of a thermoplastic material, said substrate having a thermally insulating spacer in contact with said second, lower surface thereof;

(b) providing a stamping/imprinting tool including a stamper/imprinter having an imprinting surface comprising a negative image of said pattern to be formed in said surface of said substrate, wherein said stamping/imprinting tool includes first, upper and second, lower mounting means for respectively mounting thereon said stamper/imprinter and said substrate, each of said first and second mounting means including heating means for maintaining the respective mounting means at said pre-selected first temperature;

(c) maintaining said stamper/imprinter of said stamping/imprinting tool at a pre-selected first high temperature close to a glass transition temperature T_g of said layer of thermoplastic material on said first, upper surface of said substrate;

(d) heating said substrate to a pre-selected second high temperature which is greater than said pre-selected first high temperature of said stamper/imprinter and greater than said glass transition temperature T_g of said layer of thermoplastic material on said first, upper surface of said substrate;

(e) transferring the heated substrate with said thermally insulating spacer to said stamping/imprinting tool and placing said second, upper surface of said heated substrate in overlying relation to said second, lower mounting means;

(f) urging said heated substrate against said imprinting surface of the heated stamper/imprinter at a pre-selected high pressure sufficient to imprint said pattern in said layer of thermoplastic material on said first, upper surface of said substrate, wherein the temperature of said substrate when said urging of said heated substrate against said imprinting surface of the heated stamper/imprinter commences is above said glass transition temperature T_g of said layer of thermoplastic material on said first, upper surface of said substrate;

(g) continuing said urging of said heated substrate against said imprinting surface of said heated stamper/imprinter at said pre-selected high pressure for a pre-selected interval, during which interval the temperature of said heated substrate is lowered to said pre-selected first high temperature of said stamper/imprinter;

(h) separating said substrate with said imprinted layer of thermoplastic material thereon from said imprinting surface of said stamper/imprinter; and

(i) removing said substrate from said stamping/imprinting tool.

16. (Canceled)

17. (Currently Amended) The method according to claim ~~16~~ 15, wherein:

~~step (a) comprises providing a substrate having a thermally insulating spacer in contact with said second, lower surface thereof, whereby the rate of temperature reduction of said heated substrate from the pre-selected second, higher temperature established in step (d) is lowered~~

relative to the rate of temperature reduction obtained in the absence of said thermally insulating spacer.

18. (Original) The method according to claim 15, wherein:

step (a) comprises providing a substrate comprising Al, an Al-based alloy, NiP-coated Al, glass, ceramic, or a glass-ceramic composite material, said substrate comprising a first, upper surface coated with a layer of a polymethyl methacrylate (PMMA) thermoplastic material having a glass transition temperature of about 105 °C;

step (b) comprises providing a stamping/imprinting tool comprising a stamper/imprinter having an imprinting surface including a negative image of a servo pattern to be formed in said thermoplastic PMMA layer on said first, upper surface of said substrate;

step (c) comprises maintaining said stamper/imprinter at a pre-selected first high temperature of about 120 °C; and

step (d) comprises heating said workpiece to a said pre-selected second high temperature of about 200 °C.

19. (Original) The method according to claim 18, wherein:

step (b) comprises providing a stamper/imprinter having a Ni imprinting surface, said Ni imprinting surface including thereon a layer of a release agent.

20. (Original) The method according to claim 15, further comprising the steps of:

(j) forming said desired pattern in said first, upper surface of said substrate by a process comprising selective removal of substrate material, utilizing said imprinted layer of thermoplastic material as a pattern-defining mask; and

(k) selectively removing said imprinted layer of thermoplastic material subsequent to performing step (j).

21. (New) A method of performing thermal imprint lithography of a surface of a substrate for forming a pattern therein, comprising:

(a) providing a substrate in the form of a flat disk having first, upper and second, lower surfaces, said first, upper surface being coated with a layer of a thermoplastic material, said substrate having a thermally insulating spacer in contact with said second, lower surface thereof;

(b) providing a stamping/imprinting tool including a stamper/imprinter having an imprinting surface comprising a negative image of said pattern to be formed in said layer of a thermoplastic material, wherein said stamping/imprinting tool includes first, upper and second, lower mounting means for respectively mounting thereon said stamper/imprinter and said substrate, each of said first and second mounting means including heating means for maintaining the respective mounting means at a pre-selected first temperature;

(c) heating said substrate to a pre-selected second high temperature greater than said pre-selected first high temperature;

(d) transferring the heated substrate with said thermally insulating spacer to said stamping/imprinting tool;

(e) urging said first, upper surface of said heated substrate against said imprinting surface of the heated stamper/imprinter at a pre-selected high pressure sufficient to imprint said pattern in said layer of a thermoplastic material; and

(f) continuing said urging of said first, upper surface of said heated substrate against said imprinting surface of said heated stamper/imprinter at said pre-selected high pressure for a pre-selected interval, during which interval the temperature of said heated substrate is lowered to said pre-selected first high temperature of said stamper/imprinter.

22. (New) The method according to claim 21, further comprising the steps of:

(g) separating said substrate with said imprinted layer of thermoplastic material thereon from said imprinting surface of said stamper/imprinter; and

(h) removing said substrate from said stamping/imprinting tool.

23. (New) The method according to claim 21, wherein:

step (a) comprises providing a substrate comprising Al, an Al-based alloy, NiP-coated Al, glass, ceramic, or a glass-ceramic composite material.

24. (New) The method according to claim 21, wherein:

step (b) comprises providing a stamper/imprinter having a Ni imprinting surface.

25. (New) The method according to claim 24, wherein:

step (b) further comprises providing said Ni imprinting surface with a layer of a release agent.

26. (New) The method according to claim 24, wherein:

step (a) comprises providing a stamper/imprinter having an imprinting surface coated with a layer of a fluorinated polyether compound.

27. (New) The method according to claim 21, wherein:

step (b) comprises maintaining said stamper/imprinter at a pre-selected first high temperature close to a glass transition temperature T_g of said layer of thermoplastic material on said first, upper surface of said substrate;

step (c) comprises heating said substrate to said pre-selected second high temperature which is greater than said pre-selected first high temperature of said stamper/imprinter and greater than the glass transition temperature T_g of said layer of thermoplastic material on said first, upper surface of said substrate; and

step (e) comprises commencing said urging of said heated substrate against said imprinting surface of the heated stamper/imprinter when the temperature of said heated substrate is above said glass transition temperature T_g of said layer of thermoplastic material on said first, upper surface of said substrate.

28. (New) The method according to claim 27, wherein:

step (a) comprises providing a substrate including a first, upper surface coated with a layer of a polymethyl methacrylate (PMMA) thermoplastic material having a glass transition temperature of about 105 °C;

step (b) comprises maintaining said stamper/imprinter at a pre-selected first high temperature of about 120 °C; and

step (c) comprises heating said substrate to a said pre-selected second high temperature of about 200 °C.

29. (New) The method according to claim 22, wherein:

step (d) comprises placing said second, upper surface of said heated substrate in overlying relation to said second, lower mounting means.

30. (New) The method according to claim 21, wherein:

the rate of temperature reduction of said heated substrate from the pre-selected second, higher temperature established in step (f) is lowered relative to the rate of temperature reduction obtained in the absence of said thermally insulating spacer.

31. (New) The method according to claim 30, wherein:

step (a) comprises providing said substrate with a thermally insulating spacer comprised of a glass material.